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ABSTRACT

Four papers consider the growth of telecommunications in developing countries: (1) "Telecommunications Investment in Developing Countries and the Generation of Foreign Exchange: The Impact of Electronic Funds Transfer" (Heather E. Hudson and Lynn C. York); (2) "The Effect of Information Sector Growth on Telecommunications Development Policies: A Comparative Case Study of Ireland and South Korea" (Christopher Sullivan) (58 references); (3) "Trends in International Telecommunications Development in the Third World" (Joseph N. Pelton) (abstract only); and (4) "The Rural Communication Services Project" (John K. Mayo) (abstract only). (EW)

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# TELECOMMUNICATIONS POLICY RESEARCH CONFERENCE

## Telecommunications and Growth in Developing Countries Section

Airlie, Virginia

September 27-30, 1987

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# Telecommunications Investment in Developing Countries and the Generation of Foreign Exchange: The Impact of Electronic Funds Transfer

Heather E. Hudson and Lynn C. York

Abstract:

This paper examines the foreign exchange generating potential of telecommunications investments in developing countries. Specifically, it examines the international transfer of funds by the banking industry as a means for comparing the foreign exchange generating capacity of two telecommunications technologies, the Telex general purpose system and the SWIFT network, a dedicated users' electronic funds transfer system.

Simulation models of the two systems were developed and tested using various assumptions.
In all cases the average speed of transactions using SWIFT was greater than the speed of transactions via Telex. Data for Brazil were used to show the comparative advantages of transfers via SWIFT and Telex.

A cost/benefit analysis indicates the benefits in terms of interest earnings gained when use of SWIFT enables the bank to hold its funds for transfer an extra 24 hours. The SWIFT user may then calculate the number of such transactions required to recoup the investment in the SWIFT system.

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# 1. Introduction

## 1.1 Telecommunications and Development

There is now ample evidence that telecommunications can contribute to economic development. (See for example, 1, 2, 3, 4) Underlying this sweeping assertion, of course, is the premise that information is key to the development process. Telecommunications, as a means of instantaneously conveying information, can enable individuals, private and public sector organizations, and governments to obtain and share the information they need. The benefits of these information transactions are both direct, in terms of revenues for the telecommunications carriers, and indirect, in terms of their social and economic impact for users, which may be aggregated to yield developmental benefits for the nation as a whole.

Despite the growing body of evidence on these benefits, there is massive underinvestment in telecommunications in the developing world. In many cities, service is inadequate, as potential customers languish for years on waiting lists, and

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1. Hudson, Heather E. When Telephones Reach the Village. Norwood, NJ: Ablex, 1984.

2. Saunders, Robert, Jeremy Warford, and Bjorn Wellenius. Telecommunications and Economic Development. Baltimore: Johns Hopkins, 1983.

3. Pierce, William B. and Nicolas Jequier. Telecommunications for Development. Geneva: International Telecommunication Union, 1983.

4. Information, Telecommunications, and Development. Geneva: International Telecommunication Union, 1986.

the telephone lines that have been installed are far from reliable. In the countryside, a telephone may be hours or even days away. The Maitland Commission's report The Missing Link (5) documents the need for greater investment in telecommunications, as well as for technology transfer and training in management, operations, and maintenance.

These conditions present a serious handicap for those engaged in economic activities who must rely on accurate and timely information to determine the demand for their products, to order supplies and spare parts, and to coordinate logistics or getting products to markets. This information impoverishment is ironic in an era that is becoming known as "The Information Age."

1.2 The Foreign Exchange Problem

Innovations in technology including microprocessors, small satellite earth stations, cellular and subscriber radio systems, and fiber optics have made telecommunications equipment in many cases more reliable and less costly (either in absolute terms or on a per circuit basis) than earlier generations of equipment. However, the procurement or telecommunications facilities generally requires expenditure of precious foreign exchange that may also be needed to pay for necessities such as medicine and fuel. Thus,

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5. Independent Commission for Worldwide Telecommunications Development. The Missing Link. Geneva: International Telecommunication Union, 1985.

telecommunications appropriations are viewed by finance ministries as a drain on hard currency.

The World Bank offers a quantification of this foreign exchange burden. Telecommunications projects funded by the World Bank have had a foreign exchange component of 70 per cent to 90 per cent of total project costs, as compared to agriculture projects, for example, in which the foreign exchange component ranges from 25 per cent to 40 percent of project costs.(6)

Consideration of direct effects only, however, exaggerates the foreign exchange problem. Telecommunications systems should also be a generator of foreign exchange. To the extent that they are used by businesses and industries that deal in international goods and services, their indirect benefits should also result in increasing the foreign exchange supply.

1.3 Telecommunications investment as a Generator of Foreign Exchange

Among the users that should reap the greatest economic benefits from telecommunications investment are the so-called information industries, those organizations that are primarily involved in the production, processing, or distribution of

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6. Stern, Richard. "Telecommunications investment and the Role of the World Bank." New Directions in Satellite Communications: Challenges for North and South, ed. Heather E. Hudson. Norwood, MA: Artech, 1985.

information, or the provision of information equipment and services. (7) The financial sector is highly information intensive, in that it relies on telecommunications to transmit both financial information and actual funds themselves across nations and, increasingly, around the world.

## 2. A Case Study of International Funds Transfer

### 2.1 Selection of the Financial Sector

The financial sector was chosen for analysis because it meets three important criteria:

1. A requirement for fast and accurate transmission of information;

2. Quantifiable impact of information transfer, i.e. the time value of money;

3. Relative immunity to other global variables that might affect the analysis (as contrasted to markets for agricultural commodities, for example, that are affected by changes in demand and weather conditions).

The banking industry is highly information intensive. One of their information functions, international funds transfer, was chosen for this analysis for the following reasons:

1. Most of the inflows and outflows of foreign exchange occur in the process of funds transfer;

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7. For a typology of the information sector, see Porat, Marc. The Information Economy: Definition and Measurement. Washington, D.C.: U.S. Government Printing Office, 1977.

2. A large percentage of all international transactions occur within funds transfer systems, as opposed to domestic transactions, many of which may be handled in person or by mail;

3. Telecommunications systems play a major role in the total transfer system;

4. As in all banking functions, "time is money." The speed of the funds transfer can directly affect the revenues of both the bank and its customers.

## 2.2 Telex and SWIFT

This study analyzes two systems commonly used for international funds transfer, the ordinary free field Telex message system in use for decades, and SWIFT, a more technically sophisticated dedicated users' system introduced in 1977.(8)

Telex is a public system that carries any message that can be typed into a basic Telex terminal. Banks have adapted the free field form of Telex for international funds transfer by using a complex coding system that requires both the encoding and decoding of each message at the sending and receiving banks respectively.

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8. SWIFT is the abbreviation for the Society for Worldwide Interbank Financial Telecommunications.

SWIFT is a "computer controlled system for transmitting messages between banks."(9) According to SWIFT, advantages of its system over Telex include:

1. increased speed of message communication;

2. Efficiency in message sending derived from standardized formats;

3. increased message security, as a result of a code system;

4. inexpensive incremental (per-message) costs;

5. Ability to transmit messages for a variety of transaction types. (10)

Of these characteristics, the present analysis concentrates on the measurement of speed of the two transfer systems, since this variable is most influenced by telecommunications technology.

## 3. Methodology

### 3.1 The SLAM Model

The operations research technique of computer simulation offers the best means of comparing the SWIFT and Telex systems. This technique employs powerful computer software to simulate mathematically a well-defined system through use of a stated set of parameters and variables. The SLAM (Simulation

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9. Newman, Samuel. "How Irving Trust Benefits from Swift." Unpublished article, 1985, pp. 1-2.

10. Ibid., pp. 1-2.

Language for Alternative Modeling) model was chosen for this study.

The simulation models the international funds transfer system, defined as the one-way path for international banking transactions, including both human and technological processing. The bounds of the system are the beginning and end of a transfer from one bank to another. An arrival of a transaction request at a bank marks the beginning of the process. The process terminates when a transaction arrives at its destination bank and that bank opens for the business day. The various steps in the process are shown in Figure 1.

3.2 Data Sources

Primary data sources included:

1. Detailed descriptions of Telex and SWIFT including parameters of time, labor, message path, and technology that were obtained from a major bank; (11)

2. Data on the usage level of SWIFT on a monthly basis broken down by country that were obtained from SWIFT operational reports for January 1985. (12)

4. The Model Applied to Brazil

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11. Interview with Ray Hurley, Assistant Vice President, Interfirst Bank, Dallas, Texas.

12. SWIFT Monthly Operational Reports, January, 1985, supplied by Board Member, Samuel Newman, Irving Trust, New York City.

Rather than simulating international funds transfer by an imaginary bank in an unspecified developing country, we decided to apply the model to an actual case. Brazil was chosen because of its well developed domestic banking system and its prominence in international trade. Data on all SWIFT transactions for January, 1985, by the 26 Brazilian banks that are SWIFT members were used for the analysis.

The identification of a location allows specification of operational details for the model including numerical estimates and statistical distributions, as shown in Table 1. For the basic model, the messages in both the Telex and SWIFT models are traveling to a bank in the same time zone as the sending bank. Both models have four clerks ("servers") processing the requests for transfers. In addition, the Telex model has the added parameter than accounts for processing errors that are detected only at the destination bank. Finally, the basic model contains the assumption that the Telex system uses the public communication network (with a mean transmission time of 30 minutes), whereas the SWIFT system uses a leased line (with a mean transmission time of 10 minutes).

4.2 Results of the Simulation

Without exception, comparative simulation runs showed that transactions sent over SWIFT traveled much faster than messages sent by Telex.

The time-in system result marks the average number of hours required for a message to travel from the beginning to the end of the system. On average, a transfer within the SWIFT network will arrive at an open destination bank 7.13 hours after a request for a fund transfer comes to the sending bank. An identical message traveling in the Telex network arrives at the open destination bank after 13.4 hours. Thus, the SWIFT message takes 46.7 per cent less time to arrive at its destination.

This disparity increases dramatically when minimum and maximum times are compared, i.e. minimum times of .30 hours for SWIFT and .93 hours for Telex, and maximum times of 16.40 hours for SWIFT and 38.20 hours for Telex. Managers might use the minimum time to estimate the fastest time for an urgent transaction. Similarly, the maximum time shows what could happen to a transfer if everything went wrong in terms of timing, processing errors, long waiting periods, and so on.

4.3 Sensitivity Analysis

A sensitivity analysis was conducted to test the effects of each of the following assumptions:

1. processing errors
2. number of service personnel
3. time zone differences
4. communication networks (public vs. leased

lines)

The analysis showed that none of the variables individually had an overwhelming impact; i.e. a change in any one of these variables would not significantly change the outcome of the transmission time advantage of SWIFT over Telex.

Although the range of the speed difference between the two systems varied according to the assumptions of each model, no parallel model tested showed Telex working faster than SWIFT. For a more detailed discussion of the sensitivity analysis, see (13).

## 5. An Analysis of Costs and Benefits of using SWIFT

### 5.1 Cost of the SWIFT System

To determine the significance for banking institutions of the time advantage of funds transfer using SWIFT compared to Telex, it is necessary to attempt to quantify the value of SWIFT's speed superiority.

It is not appropriate to make a direct comparison between costs of SWIFT and costs of Telex. Most banks have already made an investment in a Telex system, and may use it for other communications tasks. Thus, the costs of the Telex system

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13. York, Lynn C. "Foreign Exchange Issues in the Financing of Telecommunications in Developing Countries: A Comparison of International Funds Transfer Technologies." Unpublished MA/MBA thesis, University of Texas at Austin, 1985.

represent sunk costs, and the SWIFT network represents an incremental investment. It is therefore necessary to examine only those costs which occur when SWIFT is added to a banking organization. Table 2 shows the costs involved in investment in the SWIFT network.

In total, the "start-up" costs for the addition of the SWIFT system are approximately $70,000 to $100,000. We next weigh these capital costs against an example of the benefits a bank can achieve from the investment.

5.2 Weighing the Costs vs. Benefits of the SWIFT System

It is not possible to gain access to specific bank transaction data that would demonstrate the total savings associated with funds transfer. However, an example of the savings incurred with a sample transaction provides a rough estimate that can be used to project total savings.

The example used here involves an interbank transfer to another country of $10 million that must arrive in 48 hours. From the above analysis, it is clear that the sending bank can expect to make the deadline using either of the transfer systems. On average, the SWIFT transfer will require 7.13 hours and the Telex transfer 13.4 hours. However, the transfer could take as long as 16.4 hours using SWIFT and 38.2 hours using Telex.

If the sending bank uses SWIFT, the manager has two choices: send the transfer during the current business day, or hold the transfer to send at the beginning of the next business day.

A manager of a bank that uses only Telex has the same alternatives, but a decision to wait until the next day incurs considerable risk. A Telex sent the second business day could require more than 24 hours, and thus miss the deadline.

What would a bank gain by holding $10 million for 24 hours? If the funds were being held in an interest-bearing instrument such as a money market fund, the earnings could be substantial.

For example, at 5% annual interest compounded daily, the daily interest earnings are $1370. At 10% annual interest, the daily earnings are $2778.

Thus, the bank could recover the basic capital cost of the SWIFT system estimated at $100,000, from 73 similar transactions at 5% interest or 36 transactions at 10% interest.

Of course, other variables could affect the actual cost savings. However, this basic approach could be used to estimate the benefit/cost ratio or investment in SWIFT.

6. Conclusions

The findings of the study support five major conclusions:

1. Investment in SWIFT has a positive internal rate of return, i.e. a bank that adopts the SWIFT network can expect an increase in funds transfer speed. The value of this increased speed can be assessed to compute an internal rate of return for the capital investment.

2. Investment in SWIFT has a positive economic rate of return, i.e. SWIFT allows savings for merchants dealing in international trade when faster transfers increase cash flow efficiency.

3. The economic and internal rates of return from SWIFT use can be achieved in developing countries. Developing countries differ from industrialized countries in terms of technical expertise, labor markets, international dependencies, and economic variables. These differences, however, increase rather than decrease the value of the SWIFT network.

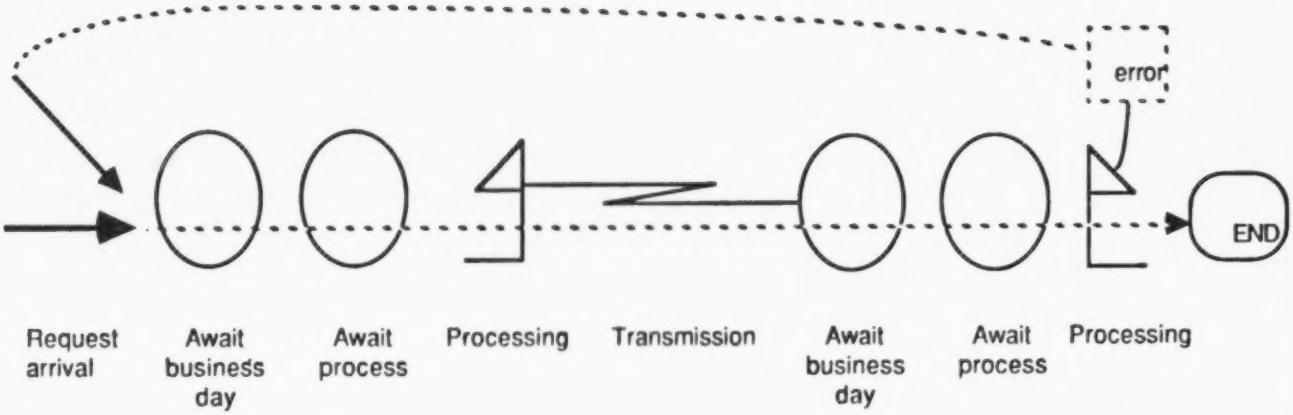
4. The quality of domestic telephone service affects the costs and speed of international transfers. Waiting times associated with congestion in the domestic service can significantly affect the time needed for funds transfer. Thus, good telephone service could increase internal and economic rates of return.

5. Most of the benefits of SWIFT use translate into foreign exchange savings. These foreign exchange savings would occur as a faunction of the volume of international business and the amount of a bank's or merchant's holdings of foreign assets. Consistent evaluation of these returns calculated for many bankers and merchants over an extended period could yield a valid range of savings that would apply for many regions or users.

7. Discussion

This study does not pretend to give final solutions to the problem of foreign exchange in the financing of telecommunications. Rather, it estimates the basic costs and benefits, in terms of foreign exchange, for one incremental information technology investment within one sector of the economy. Although the study cannot provide a conclusive answer for a banker evaluating the benefits of an electronic funds transfer system, it does provide a specific methodological framework for such an analysis.

In addition, the study should give those who make decisions about telecommunications loans some insight into the benefits, in terms of foreign exchange, of telecommunications investment. Further studies, however, applying the methodology to other investments in other sectors, may help to develop a generalizable estimate of these effects.




Basic Funds Transfer Model

## Assumptions for Basic Model of Funds Transfer Simulation

| SYSTEM ELEMENTS | TELEX | SWIFT |
|---|---|---|
| **Transfer Requests** | | |
| - # transfers/mo. | 1560 | 1560 |
| - arrival stream | exponential dist. approx = 3.25/hr. | exponential dist. approx = 3.25/hr. |
| **Await bank opening** | | |
| - banking hr. | 8/day | 8/day |
| **Processing (origin bank)** | | |
| - mean time | 30 minutes | 15 minutes |
| - # processors | 4 | 4 |
| **Transmission** | | |
| - communication type | public | closed user group |
| - mean time | 30 minutes | 10 minutes |
| **Processing (dest. bank)** | | |
| - process errors likely | yes | no |
| - time for error detect | 45 minutes | N/A |
| **RESULTS** | | |
| - Ave. time in system | 13.40 hr | 7.13 hr |
| - Min. time in system | .93 hr | .30 hr |
| - Max. time in system | 38.20 hr | 16.40 hr |

## COSTS FOR THE SWIFT NETWORK

| | Charges |
|---|---|
| **Capital Costs:** | |
| Terminal devices for SWIFT interface | $20,000-$50,000 |
| **Non-Recurring Charges:** | |
| Initial Entrance Fee | $43,510 |
| Connection/Installation Fees | $3,610 |
| Directory and Bank Address Charges | $280 |
| Total Non-Recurring Charges: | $47,400 |
| **Recurring Annual Charges:** | $2,000 |
| **Message Transmission Charges:** | |
| Normal Message | $0.33 |
| Message with Delivery Notification | $0.50 |
| Urgent Message | $0.67 |
| **Operator Training (per person)** | $1,000 |

SOURCE: SWIFT Tariff Schedule, other vendor estimates.

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# The Effect of Information Sector Growth on Telecommunications Development Policies: A Comparative Case Study of Ireland and South Korea

Christopher Sullivan

School of Communications
University of Washington
Seattle, Washington 98195

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## Abstract

The correlation between industrialization and telecommunications development is well known; less understood are the social forces generated within industry that impact the telephone system. This study proposes that a major impetus for telecommunications change in the developing world comes from the communication activity of the information sector. Data from two newly industrializing countries, Ireland and South Korea, indicate that when the information sector reaches a critical level, the demand for telecommunications service creates a communications bottleneck and telecommunication policies respond by allocating increased investment into the telephone system. Telecommunications policy planners would do well to consider this important relationship when projecting future telephone system requirements.

# The Effect of Information Sector Growth on Telecommunications Development Policies: A Comparative Case Study of Ireland and South Korea

A modernized national telephone system is now recognized as a vital factor in the development efforts of nations, similar in importance to the role given to the mass media by communications research in earlier studies of industrial and political development (Frey, 1973). The importance of telecommunications is reflected in metaphors likening it to "nervous tissue" (Théry, 1979, or as the "indispensable arterial system of the information society" (Maitland, 1984).

In the Maitland Commission's study of worldwide telecommunications problems the report stressed that "no development programme of any country should be regarded as balanced, properly integrated or likely to be effective unless it includes a corresponding priority to the improvement and expansion of telecommunications." (Maitland, 1984) The presence and use of telephone services can provide the basis for more productive business activities, which in turn raises the overall level of economic development (Bebee & Gilling, 1976; Hardy, 1980a, Shapiro, 1976; Marsh, 1976; Jonscher, 1981).

Despite some of the clear benefits obtained from the telephone system, many nations fail to invest significantly in their telecommunications infrastructure, even though there is great demand for service. (Saunders, 1983; Hudson, 1984). Or, other countries use up the capital generated by the telephone system to subsidize other government projects rather than reinvesting it into telecommunications hardware. On the other hand, a smaller number of countries, notably the newly industrializing countries (NICs) have invested heavily in their telephone systems, responding to the needs generated by their successful industrialization.

What does occur within a country to make the government decide to invest in its telecommunications infrastructure? This question is highly relevant to telecommunications policy research. There is evidence that in the NICs pressures arise that force the governments to invest in the telephone system, oftentimes leading to dramatic improvements in service. If we could understand the dynamics behind such accelerated telecommunications investment, we would gain a clearer insight into the way telecommunications policy should be addressed in the rest of the developing world.

The development of national telephone systems is generally explained as the result of industrialization, urbanization, mar-

ket forces or increases in per capita income (see: Hwang, 1986; Hudson, 1984; Saunders, 1983; ; Shapiro, 1976; Marsh, 1976; CCITT, 1968). All of these factors are important variables for understanding change in a telephone system, but none of them examines telephone development from the perspective of the people who are the heaviest users of the telephone - the information sector workers within industry. This paper begins from the perspective of the information sector, and attempts to chart the evolution of telecommunications policies in two industrializing countries as they were impacted by the growth of the information sector.

## Information Sector Growth and the Telecommunications Bottleneck

The relations among industrialization, information and telecommunications are gradually becoming clear, but the role of the information sector in this relationship is less well understood. It is taken for granted, though, in many formulations of the importance of telecommunications development. For example, at the 1979 ITU World Telecommunications Conference the Kuwaiti information minister pointedly declared that "no trade or banking operations, no operations on shares and stocks, and no improvements in educational and health facilities are possible in a country with poor telecommunications." (Al Ghunaim, 1979) Most, if not all, of the activities he mentions could be defined as information sector activities.

In an analysis of the Korean telephone system, Hwang argues that the demand for telephone connections is directly related to the need for information within the society, arising from the "expansion of economic activities and the ever-increasing trend of production and consumption activities." (Hwang, 1986) For the export-oriented industry of South Korea, and most other NICs, economic "expansion" at a basic level implies locating more international market outlets for domestically manufactured goods. The demand for telecommunications channels is thus directly related to market economics, according to Hwang.

Jussawalla (1984) draws a relation between telecommunications and the competitive conditions of international trade. She stresses the value of information inputs for successful trading relations, pointing out that competitive trade relations are offset more by productivity differentials than other factors such as wages, particularly in the information-intensive, high technology industries. Successful entry into global market economics is directly related to the quality of information flows and the availability of communication channels. Information inputs, Jussawalla argues, affect the productivity of the high technology industry by opening the way for the importation of technical information, leading to technology transfers and increased trade competitiveness.

Both Hwang and Jussawalla argue that information acts as a production input for industry, and should be included in economic

analysis along with the traditional variables of labor and capital. This formulation raises the question of how information inputs are actually related to industrial production. To answer this it is proposed that communications or information input is received through the information sector of the industrial organizations, and production benefits are passed on from there. The implication here is that the information sector plays a major role in the industrialization efforts of most countries, both as the sender and receiver of information flows, and the prime user of telecommunication channels.

The role of the information sector in the context of national telecommunication policy should not be overlooked. Communication scholars have recently begun to argue that the greatest use of telephone comes from the communications activity within institutions, both in business and the government (Jonscher, 1981; Hudson, 1984; Hardy, 1980). Communication activity within business is assumed to be a stable proportion of the total business activity (Jonscher, 1981). If the level of business activity remains constant so does the communication activity; but with an increase in business activity, as occurs with industrial development, the level of communications activity will also increase. This gets translated into greater demand for telephone connections and service.

The ability of the telephone system keep up with industrial growth is limited by its technological capabilities. Increasing the capacity of the telephone system can be difficult with antiquated telecommunications technology; yet if the telephone system is not upgraded a communications bottleneck can occur that ultimately becomes detrimental to industrial growth. Technological change in the telephone system can occur as a slow build-up of the system, but more often it will accelerate at a critical point in a nation's development process (Sullivan, 1987; Grabhorn, 1979; Tyler, 1979). The acceleration of telephone development is often the result of government policies directed at a telecommunications bottleneck that threatens the course of national development.

Communications and information can be viewed as related production inputs that affect industrial production through information sector activities. Hwang, 1986; Jussawalla, 1984; Jonscher, 1981; Marsh, 1976) Conversely, information sector activities should affect the demand for telecommunication facilities which are necessary for continued industrial growth. Hence, it is hypothesized that the growth of a country's information sector impacts telecommunications policy decisions to invest in telecommunications development.

The intent of this paper is to chart the relations among three factors: information sector growth, telephone demand, and telecommunications policy leading to increased investment in telecommunications development. In proposing that information sector growth will influence telecommunications policy via telephone demand, resulting in accelerated telecommunications

development, time is introduced as a factor in the sequence of events. While we might expect that the growth of the information sector and telephone demand would occur within the same time frame, it is likely that there is a time lag between the period when the information sector begins to generate greater demands for telephone services, and when it finally has an impact an telecommunications investment and development.

## Definition of Major Concepts

The concept of the information sector groups people working in occupations that entail information "handling" or "manipulation" as their primary work activity (Schement & Lievrouw, 1984). Machlup (1962; 1980) introduced the idea of the knowledge industry as a significant part of the American economy in the early 1960's, demonstrating that increasing numbers of people were engaged in information-related jobs. Bell (1973) supported this thesis a decade later, arguing that changes in the composition of the labor force in the United States toward the service and professional sectors, was leading the way to a new knowledge society. (See also, Masuda, 1980)

Several scholars have tried to pin down and measure the somewhat nebulous concept of "information work". Porat's (1975) definition of information occupations relies on the Standard Industrial Classifications (SIC) as a basis for categorization. He was followed in this classification by OECD researchers and others (OECD, 1981; Jonscher, 1981). Schement and Lievrouw (1984) defined information work based on behavioral descriptions in the U.S. Dictionary of Occupation Titles (DOT). In general they include all jobs which entail the creation of information, the processing and transmission of information, and its storage.

These classifications were followed by efforts to measure the size of the information sector. Porat's (1977) research on the information sector in the United States showed that by the mid-1970's more than 50% of all people were employed in information occupations. Schement analyzed the composition of the California labor force in 1980, and identified 48% of all workers as "creating or manipulating information" (Schement, et al, 1983).

An OECD (1981) study found that information occupations had increased substantially in Europe during the post-war period; three quarters of the growth came from increases in the service sector. The OECD results are summarized in Table 1, which shows the change in the percentages of information sector employment in nine of the OECD countries. The data indicate that in the industrialized countries there has been a steady change in employment patterns towards greater information-intensive work. The majority of the jobs created in this sector came from white collar positions. As we shall find, similar changes occurred in the NIC countries, although at a later period (see, for example, Katz, 1987)

Table 1: Percentage Employed in Information Occupations

| Country | 1955 | 1965 | 1975 |
|---|---|---|---|
| United States | 33.0% | 38.0% | 43.5% |
| Canada | 32.0% | 35.5% | 41.0% |
| United Kingdom | 29.0% | 33.0% | 36.0% |
| Sweden | 23.5% | 28.0% | 34.9% |
| West Germany | 21.5% | 25.5% | 32.0% |
| France | 21.0% | 25.0% | 32.0% |
| Austria | 20.0% | 24.5% | 30.0% |
| Japan | 13.0% | 22.0% | 29.9% |
| Finland | 12.0% | 16.0% | 25.5% |
| Mean Percentage: | 22.9% | 27.5% | 33.9% |

From: OECD, Information Activities, Electronics and Telecommunications Technologies, 1981

In this study data published by the International Labour Office, Yearbook of Labour Statistics, is used to measure changes in the employment patterns of each country analyzed. The ILO provides annual employment statistics grouped by industrial sector and occupational classification for most countries in the world. Measurement of the information sector is accomplished by adding the employment totals within each of the occupational classifications identified as 1) Professional, 2) Administrative, 3) Clerical and 4) Sales by the ILO. These categories include occupations that are very close to Porat's (1975) lists of information sector jobs. In aggregate they can be taken as the information sector of a country; all other occupational categories combine to form the "non-information" sector.

The demand for telephone service has been studied in many different contexts. The demand for telephone services can be separated into several related aspects: 1) the total demand for telephone connections made up of the installed telephones and those who have applied for telephones, 2) unmet demand for telephone connections made up of customers who are on the waiting list for telephone connection, and 3) the actual use of the telephone, as indicated by traffic patterns over the telephone system. (see, for example, Bakry, et al, 1987). In this study I am concerned with the second two factors, unmet demand for connection and telephone traffic.

Marsh (1976) relates the demand side of telephone service with the rising income levels of the population brought on by economic development; he argues that telephone demand can be used as an indicator of economic development - when people can afford telephones, they want them. Shapiro (1976) introduces technological and cost factors in his discussion of telephone demand. If the telecommunication technology is old or inefficient, or the tariffs for service are too high, then the demand for telephone service will be constrained by these factors. Demand

for telephones is controlled in many countries by tariff structures which make it too expensive for people to afford. Saunders (1983) points out that demand is often underestimated because the perception of the non-availability of telephones keeps many people from signing onto a waiting list; he includes black market telephone trade as an additional indicator of the true demand for telephones.

Business demand for telephone connections is somewhat different from residential demand. It is recognized as a "necessary goods" (Hong, 1986) in business, returning more in benefits than its cost (Pierce & Jequier, 1983; Parker, 1981; Hardy, 1980). Industrial or business use of the telephone is related to the economic market activity which increases the need for information and adequate communications facilities (Hwang, 1986; Jonscher, 1981; Shapiro, 1976; Marsh, 1976).

Chu (Chu, et al, 1985) demonstrates the reliance on telephones when when they are available in a survey on telephone use in Thailand and Indonesia. A large proportion of the daily calls were in the context of office work, or for business related calls from the home. In Thailand 60% of office workers responded to his survey that the lack of a telephone would interfere with their work. For the administration of rural development programs in Indonesia the telephone is a vital link between government offices and outlying regions. Overwhelmingly, people who had access to telephones were unwilling to forego them for other means of communication.

The salient point to emerge from this study is that use of the telephone is related to information work, and activities that require reliable communications, which take place in the bureaucratic or business context of the information sector.

Connecting telephones to the system means that there must be enough telephone lines to carry the traffic, and powerful enough switching exchanges to provide adequate connection capacity. And there must also be enough skilled manpower to install the telephone sets and provide maintenance for the telephone facilities. (Butler, 1985; Shapiro, 1976) A sudden increase in applications for telephone connections can overburden a country's PTT by creating an accelerating backlog of customer applications, or a "bottleneck."

Demand on the telephone system in the form of calls or telephone traffic puts pressure on the performance and reliability of the telephone system. Increases in traffic can affect the operating performance of the switching exchanges, resulting in unacceptably high blockage rates in which telephone calls do not get through because there are no available circuits (Dargan, 1979). The installation of telephones and use of the telephone system are obviously related: the more telephones there are, the more traffic there will be.

In this study demand factors are measured in terms of

waiting list statistics and telephone traffic data. Both of these are available through the International Telecommunications Union Yearbook of Common Carrier Statistics, which carries annual data on telephone systems for most countries of the world.

The role of policy in telecommunications development is quite diverse, covering a range from regulation of the industry, setting tariffs and standards, projecting development goals and determining the level of telecommunications subsidies (see, for example, Saunders, 1983; Hudson, 1984; Yurow, 1983). This paper addresses itself to a very narrow view of telecommunications policy - that of deciding to invest in telecommunications development. Data pertinent to this view of telecommunications policy is presented at two levels, government documentation and the amount of capital invested in telecommunications as published by the ITU Yearbook of Common Carrier Statistics.

Telecommunications development is considered to follow from capital investment, so is not dealt with at length in this study. Mention is made of telephone density levels, the number of main lines, and other facets of telecommunication equipment, but there are no tables as such to demonstrate changes in the amount of telephone hardware in a country. Statistical data on the level of telecommunications equipment in most countries is available in the ITU Yearbook of Common Carrier Statistics, AT&Ts The World's Telephones., and statistical reports from each country.

In order to answer the questions raised concerning the information sector's impact on government policies to invest in telecommunications, the data from two countries are compared in this study: Ireland and South Korea. These countries were selected on the basis of industrial similarities. Both are "colonial" nations, predominantly agricultural at the beginning of their development plans. Both depend largely on exports to support their industrialization efforts, and both have elected to encourage electronics and telecommunications industry development. In both countries rapid industrialization was accompanied by a critical bottleneck of the telephone system, and subsequent telecommunications policy decisions to invest heavily into the telecommunications infrastructure. They therefore present comparable examples of NIC development.

## Comparative Case Studies

### I. Ireland

### Introduction

In 1978 the country of Ireland experienced the greatest economic growth in its history. Yet just as the government's development strategy to foster an electronics industry was successful beyond anyone's hopes, the national telephone system was failing faster than anyone expected. The ascendancy of industry had forced the Posts and Telegraphs into a bottleneck in

which new telephones and transmission lines could not be installed fast enough to meet the increasing demand for them. The negative consequences of this telecommunications bottleneck on future industrial growth quickly became apparent to the government, which responded with calls for an accelerated telephone development program.

A government White Paper, the "Programme for National Development, 1978-1981" stressed the importance of telecommunications development for continuing industrial growth: "Because of the critical importance of the telephone service for industrial expansion and job creation as well as its social role and because of the greatly expanded demand recently for service arising from improved economic conditions..." (Oireachtas nah Eireann, 1979).

The need for telecommunications development was both recognized and acted upon. The 1979 White Paper projected a cost of 350 million pounds to upgrade the telephone system. By 1985 the government had spent three times that amount to introduce the most advanced telephony equipment into the Irish telephone network, and re-organized the telecommunications administration into a semi-private company, An Bord Telecom Eireann.

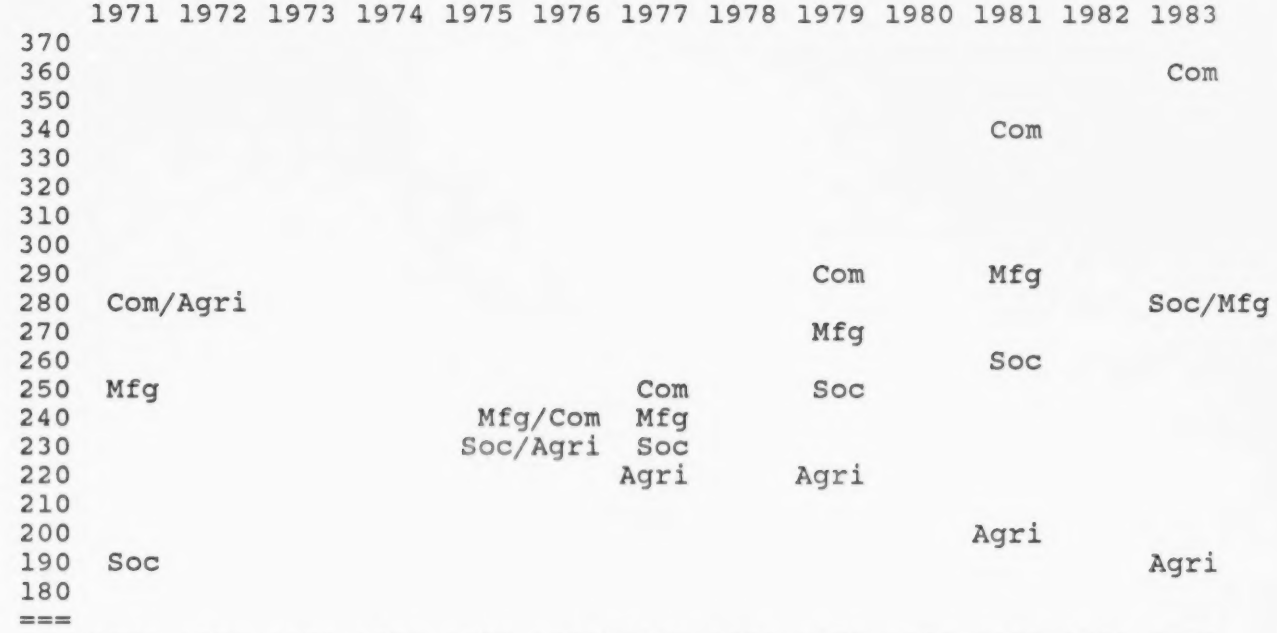
## Irish Industrialization and Growth of the Information Sector

Irish industrialization began in earnest in the early 1970s, following the government's "Third Programme for Economic and Social Development, 1969-1972," which emphasized high technology industry as an appropriate course of development. Irish governmental agencies such as the Industrial Development Agency were highly successful in enticing multinational companies to establish plants in the country. This led to unprecedented growth in the Irish electronics industry, with concomitant increases in employment.

The composition of the Irish work force also changed with industrialization. The number of people working in agriculture diminished as young men and women left the farm to find work in the cities and industrial estates established in the rural areas. The greatest increase in jobs did not come from the manufacturing sector, however, but from the service industries. Figure 1 shows the changes in employment composition between the years 1971-1983. (ILO, 1974-1985)

It can be seen that the service sectors of the economy generated more employment than any of the other sectors. Agriculture showed a definite decline, while the growth of manufacturing paralleled the industrial development and expansion in the late 1970's, then declined with the recession of the early 1980's. In contrast to these three industries, the commercial industries and social services demonstrate a strong growth in employment through the decade, and into the 1980's. In particular, the service industries, led by the financial and trading organizations, emerged as the strongest employment sector of all the industries.

Figure 1: Employment in Irish Industries, 1971-1983
(X 10^3 Persons Employed)




Agri = Agricultural Employment  Mfg = Manufacturing Employment
Com = Commercial and Services Employment  Soc = Social Services

The changes in the composition of Irish employment had a great effect on the proportion of people working in the information sector of industry. While most of the jobs opening up in the manufacturing sector were assembly line positions, the commercial sector opened up office positions. To demonstrate the differences in the proportion of information sector workers in the different industrial sectors, Table 2 presents a percentage breakdown of information sector versus non-information sector jobs in each of the industries for 1979. (ILO, 1979)

Table 2: Information vs. Non-Information
Jobs in Irish Industries

| Industry | %I.S. | %N-I.S. |
|---|---|---|
| Agriculture | .79% | 99.2% |
| Construction | 6.9% | 93.1% |
| Manufacturing | 22.7% | 77.3% |
| Service Industry | 55.5% | 44.5% |
| Social Services | 66.8% | 33.2% |

It is evident that the majority of jobs in both the service

industries and the social services fall within the information sector; about a quarter of the manufacturing employment is in this area, and much less for construction and agriculture. If we compare changes in the total amount of information sector employment against the non-information sector employment over the decade, it again becomes evident that much of the new employment in that period came out of the information sector. The percentage increase in the information sector between 1971 and 1983 was 36.6%; the percentage change in non-information employment was only 11.8%. These figures imply that as the economic development in Ireland created jobs, the majority of the new work was in information sector jobs.

Demand Patterns in the Irish Telephone System

For many years the Irish Posts and Telegraphs had deliberately controlled the growth of the telephone network by discouraging the public demand for service. No efforts were made to "sell" telephones, and the department's policy of insisting on pre-payment of one year's rental by all new customers was designed to contain latent demand within manageable limits. (Dargan, 1979) The explanation for this practice was that the department had to ration its available resources, particularly skilled staff, to meet the demand for telephone service that did arise.

However, in the mid 1970s the demand for telephone connections suddenly exploded, with new applications piling up faster than the P&T could install telephone sets. The bottleneck created by the increase in applications for telephone connection began around 1977, with the number of customers on the waiting list rising rapidly for the next three years. The waiting list figures presented a great problem for the P&T because the number grew so rapidly in such a short time, pushing the telephone company past its ability to cope with new applications for connection.

Table 3 presents the increase in the number of customers on the waiting list for telephone connection between 1972 and 1982. (ITU, 1983, 1984; Telecom Eireann, 1985)

Table 3: Irish Telephone Demand, 1972-82

| | 1972 | 1974 | 1976 | 1978 | 1980 | 1982 |
|---|---|---|---|---|---|---|
| Waiting List | 22.5 | 42 | 40 | 63 | 90 | 78 |
| Telephone Traf. | 576.1 | 726.8 | 827.1 | 1130 | 1615.2 | 1686.58 |
| Telex Traffic | 6954 | 8850 | 10609 | 11776 | 18552 | 18867.2 |

Waiting List X 10^3 applications
Telephone Traffic X 10^6 calls
Telex Traffic X 10^3 minutes

By 1978 the waiting list for new telephones came to 63,000

applicants, a figure never anticipated; by 1980 the waiting list had grown to 90,000, about 40% of which were businesses, which traditionally had priority over residential telephones. (Dargan, 1979) The average waiting period for telephone installation was 14 months.

The rise in telephone traffic volumes during this period, as shown in Table 3 (ITU, 1983, 1984), also gave rise to problems for the P&T. Due to network congestion the failure rate of both local and long distance trunk calls rose to debilitating levels by the end of the 1970's. The network congestion was primarily due to inadequate switching exchanges and deficient capacity in the main transmission lines. By the late 1970s it was common for newspapers to run stories about foreign companies pulling their operations out of Ireland because it was impossible to place a phone call in or out of the country (Bowes & Sullivan, 1985).

The combination of these two factors - application for connection and telephone traffic - pushed the Irish P&T into a telecommunications bottleneck. The only way to solve this problem was by seriously investing in modern telecommunications hardware.

Irish Telecommunications Policy

The Irish government responded to the worsening situation of the telecommunications bottleneck in the late 1970's by calling for more rapid network expansion. Ultimately it undertook the complete restructuring of the Posts and Telegraphs department. In the first policy statement to address the telecommunications bottleneck, the "Programme for National Development, 1978-1981" proposed that the annual rate of connections should nearly double to 80,000 per year, endorsed the installation of automatic exchanges in major cities, and micro-wave transmission to serve the national and international network. (Oireachtas nah Eireann, 1980)

However, demand for telephone service continued to rise "greatly in excess of the forecasts on which the programme was based." (Dargan, 1979, p.26) Two years later the government again revised its telecommunication policy in a Green Paper on the "Reorganization of Postal and Telecommunications Services". The paper called for "an accelerated telecommunications programme" aimed at raising the "quality of the telephone, telex and data services for subscribers to the level of other EEC countries, and maintain it at that level." (Oireachtas nah Eireann, 1980, pp.7-8.)

Following its call for an accelerated program to develop the telecommunications network, the government greatly increased the amount of money invested into the telephone system. In 1980 the government nearly doubled its investment into telecommunications, and did the same in 1981. Over the next five years the Irish government invested 1 billion Irish pounds into the telephone network (Byrnes, 1983) to bring it up to the quality of other European telephone systems. Consequently, the Irish telephone

system has emerged as one of the most modern systems in Europe.

Finally, in a step intended to raise the operating efficiency and solvency of the telecommunications system, the P&T was totally reorganized by the passage of the "Postal and Telecommunications Services Act, 1983." The new company, An Bord Telecom Eireann, was to be a profit-oriented semi-state company, independent from the government, with the "exclusive privilege" of offering telecommunications services in Ireland (Ragget, 1984). With this policy directive, Ireland joined the growing number of developed countries which have likewise privatized their telecommunication authorities.

Conclusion

When the changes in Irish industrial and telecommunications infrastructures over the past decade are summarized, the simultaneity of both development patterns points to a relationship between the two. The phase of rapid industrialization accompanied a surge in demand for telephone connections and unprecedented volumes of telephone traffic moving over the system. The resulting telecommunications bottleneck was followed by heavy government investment and corresponding technological development of the telephone system. The industrialization process was marked by the growth of a significant employment subsector, the information-intensive jobs grouped as the information sector, that contributed significantly to the telecommunications bottleneck.

Given the theories connecting the information sector with the use of telecommunications channels, the parallel growth of Irish information sector employment and the volume of telephone traffic suggests that the two are related. A second parallel exists with the rise in applications for telephone connections during the same time period. The government record indicates that the demand for telephone services arising from the industrialization process was a vital factor in the decision to accelerate development of the system; it was the enormous backlog of waiting customers that became the final straw for the Irish P&T.

Government investment into the telephone system was clearly based on the need to service Irish industries as an economic priority. The twin factors of telephone traffic and demand for phone connections set the stage for the overload of the telephone system, and these in turn are related to the growth of the information sector within the industrialization process. Thus, the information sector emerges as a driving force behind Irish telecommunications development.

## II. South Korea

### Introduction

The remarkable success of South Korean industrialization is the result of consecutive Five-year Plans which carefully mapped out the nation's industrial needs. The course of industrial development led from labor-intensive basic industries in the early 1960s to the capital intensive high technology industries of the 1980s. Each Five-year Plan stressed the importance of building a strong export-based economy, a strategy which has resulted in South Korea becoming a model of industrialization for the rest of the developing world.

The telecommunications system was incorporated into national development plans from the beginning, but its development was relatively slower than the growth of industry. Despite steady increases in transmission lines and switching exchange, South Korea still had a fairly low telephone penetration rate at the end of the 1970s. But during this period the demand for telephone connections exploded beyond the PTT's ability to install telephones. Between 1976 and 1979 the number of people on the waiting list for a telephone doubled, creating a bottleneck in the provision of telephone service.

In 1980 the government announced a new telecommunications policy that placed a priority on developing first quality telephone services. This goal was to be achieved in several ways: 1) by meeting the demand for telephone connections without delay, and ensuring that future applications for connection could be processed on demand; 2) by upgrading the telephone system through the construction of automatic switching facilities in rural areas to make telephones available to the smallest village; 3) by initiating the construction of an integrated services digital network (ISDN) to provide digital transmission and packet switching for both voice and data communications.

The government demonstrated its seriousness by investing more than 1 billion Won in telecommunication development funds over the following five years. It also privatized the PTT by incorporating the Korean Telecommunication Authority in 1982, and set the stage for the digitalization of the entire telecommunications network. In doing this, the South Korean government was anticipating the country's evolution into an "information-intensive society" in which telecommunications would play a vital role (ETRI, 1985).

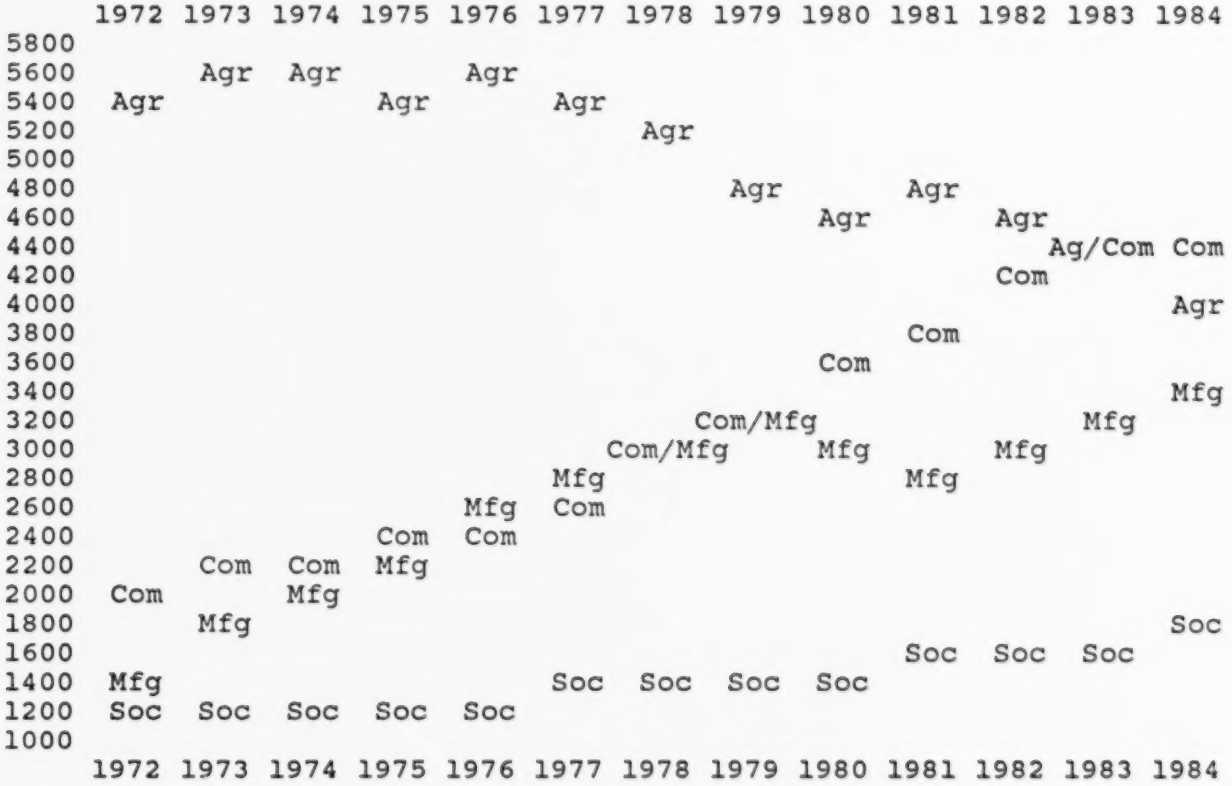
### Growth of the Information Sector in South Korea

Over the past 25 years South Korean industrial policies have been characterized by an outward oriented strategy that rewarded export-based manufacturing goals, and guided the course of manufacturing from labor-intensive products to capital intensive investment in high technology and heavy industries. The electronics industry, in particular, was designated as a "strategic

export industry" and given a variety of incentives and privileges to encourage its growth.

The success of industrialization brought the growth of new industries, surging exports, increasing per capita income and major shifts in employment composition. The greatest employment decline came in the agricultural sector. Manufacturing employment increased with the steady growth of industry, but was outpaced by employment in the commercial and service sectors. Figure 2 shows the changes in employment composition in South Korea between 1972 and 1984.

Figure 2: Employment in South Korean Industries, 1971-1983
(X 10^3 Persons Employed)




Agr = Agricultural Employment  Mfg = Manufacturing Employment
Com = Commercial and Services Employment  Soc = Social Services

It is clear from the data that employment in the commercial and services sectors kept pace with employment in the manufacturing sector until 1980, when manufacturing went into a temporary decline. The commercial and services sectors continued to grow at the same pace. The type of jobs within these two sectors was very different. The manufacturing jobs were mostly in assembly work; the jobs in the commercial sector were weighted towards white collar positions. The difference in information

sector employment in the two sectors can be seen in Table 4, which presents a breakdown of information sector versus non-information occupations in each of the industries in 1980. (ILO, 1984, p.188; Hwang, 1986)

Table 4: Percentage of Employment in Information Sector Jobs and Communication Inputs in Selected South Korean Industries

| Industry | %I.S. | %N-I.S. | Comms Inputs |
|---|---|---|---|
| Agriculture | .2% | 99.8% | .00065 |
| Construction | 17.4% | 82.6% | .00226 |
| Manufacturing | 19.3% | 80.7% | .00212 |
| Comms/Transport | 31.3% | 68.7% | .00606 |
| Social Services | 58.3% | 41.7% | .00635 |
| Trade/Hotels | 74.9% | 25.1% | .02548 |
| Finance/Insurance | 87.6% | 12.4% | .01218 |
| Total Industry | 29.0% | 81.0% | .00492 |

It is clear from this table that manufacturing has a much smaller information sector component than the commercial and service sectors which include trade, hotels, finance and insurance corporations. As the commercial and service sectors grew, the number of information sector employees also increased. Indeed information sector jobs grew at a much faster rate than non-information jobs. Between 1972 and 1983, information sector employment grew by 125%; in the same period non-information sector employment increased only 25%.

Table 4 also compares the different industrial sectors by their aggregate telecommunication inputs, based on Bank of Korea statistics for 1980 (Hwang, 1986). It appears as no coincidence that the heaviest users of communication inputs also have the greatest proportion of information workers employed within them. The table demonstrates a distinct ordinal relation between the proportion of information workers in an industry, and the level of that industrial sector's communications input coefficient. When we compare the level of information sector employment in each of these industrial sectors, we can easily see how the information sector is related to the use of communications inputs.

It seems clear that the industrialization process in South Korea brought with it a tremendous growth of the information sector. Given the apparent relation between the proportion of information workers and the use of communication inputs, this growth also brought increases in the demand for telecommunication services. The growth of the information sector undoubtedly contributed to the surge of demand for telephone connections that initiated the telecommunications bottleneck at the end of the 1970s.

Telephone Demand Patterns in South Korea

From the beginning of the Five-year Plans, demand for telephone connections had consistently stayed ahead of the ability of the South Korean PTT to install telephone equipment. A steady demand for telephone connections had always come from Korean businesses, and the possession density of business telephones remained above that of residential telephones until 1980. The telephone was considered a "luxury" item in Korea, available only for the wealthy; the cost of installing and maintaining a telephone was on par with the cost of purchasing an automobile (Lee, 1986). Despite these cost constraints, the telephone was regarded as a desirable item, one which contributed positively to the quality of life (Eun, 1985).

In 1975 the number of new applications began to run ahead of the connection ability until by 1980 the seriousness of this telecommunications bottleneck became apparent in the tremendous backlog of applications. The sudden increase in applications for telephone connection came from residential users, at a time when per capita income was on the rise (Hwang, 1986; Hong, 1986). Demand for telephone connections also increased in the business sector, as well as demand for telex lines. Table 5 shows the rise in demand for telecommunication services between 1972 and 1982. (ITU, 1983, 1984).

Table 5: South Korean Telephone Demand

| | 1972 | 1974 | 1976 | 1978 | 1980 | 1982 |
|---|---|---|---|---|---|---|
| Waiting List | 13.03 | 77.06 | 144.38 | 418.09 | - | 427 |
| Nat'l Tel. Traffic | 135 | 187.9 | 3690.4 | 5124.2 | - | 25968 |
| Out Int'l Tel. Traf. | .68 | 1.219 | 1.534 | 2.033 | - | 3.6 |
| Int'l Telex Traffic | - | 2362 | 5181 | 9714 | 11815 | 6949 |

Waiting List X 10^3 applications
National Telephone Traffic:
1972-74, X 10^6 calls; 1974-82, X 10^6 pulses
International Telephone Traffic X 10^6 calls
Telex Traffic X 10^3 minutes

Increases in the amount of telephone traffic also affected the telephone system. As indicated in Table 5, the volume of national telephone traffic increased sharply after 1975; between 1978 and 1982 the volume of national telephone traffic quadrupled. (It is difficult to compare growth in telephone traffic over the entire period because the method of tallying calls changed in 1975. Up until 1974 the traffic was metered in number of calls; after 1974 it was metered in pulses.) International telephone traffic maintained a steady growth until 1979 when it, too, began a steeper ascent. Much of the growth in telephone traffic might be explained by the number of telephones being installed on the network. But the increase of traffic in the five years preceding the government's accelerated development

plan in 1980 suggests that it, too, contributed to the telecommunications bottleneck.

South Korean Telecommunications Policy

The first Five-year Plan (1962-1966) in South Korea proposed the goal of ensuring basic communication facilities for both rural and urban areas. The target of the second Five-year Plan (1967-1971) was to "expand international and long distance transmission lines," and that of the third Five-year Plan (1972-1976) to "expand and improve rural communication networks so as to ensure the balanced development of urban and rural areas." (ETRI, 1985) The telephone system was perceived as a necessary factor in the development process, and it was expected to contribute to the "sustained growth" of the agricultural sector. (Korea Observer, 1974)

The target for the fourth Five-year Plan (1977-1981) was to "lay the foundation for the expansion of communication facilities." (ETRI, 1985) By its end the Korean PTT was facing an enormous backlog of applications for telephone connection and improved telecommunication services. In 1980 the government instituted telecommunication policies designed to ensure the rapid connection of all applicants for a telephone. This policy was underscored in the fifth Five-year Plan, and the goal became one of meeting demand as it arose. One target set by the Ministry of Communications was the installation of one million new lines a year beginning in 1982. (ETRI, 1985)

In order to reach the goal of making telephones available to the whole population, and laying the foundation for the future integrated systems digitalized network (ISDN), the Ministry of Communications (MOC) proposed a budget of 5 trillion Won (equal to approximately $7 billion in 1981) over the next five years. The amount of money put into telecommunications development clearly demonstrates the government's perception of the importance of telecommunications for the future economic development of South Korea. Between 1980 and 1986 the number of transmission lines in the country quadrupled, and telephone density doubled.

In 1982 the MOC privatized the telecommunications authority, incorporating the Korean Telecommunication Authority (KTA) as "a government-funded public firm." (Jung-Jun, 1986) The KTA was given managerial authority over all voice communications with the responsibility of installing new switching exchanges, transmission lines and telephone connections. The MOC also founded the Data Communications Corporation of Korea (DACOM) as a joint venture between private investors and the South Korean government to act as the common carrier for data communications.

The dramatic changes wrought in the South Korean telephone system at the beginning of the 1980s should be viewed in the context of South Korea's economic development priorities. Communications had always been perceived as an infrastructural com-

ponent of industrial growth; with the bottleneck of telecommunications that occurred in the late 1970s South Korean policy dealt with the problem in a most effective and dramatic fashion. The telephone system in South Korea is now poised toward the future, and the development of integrated digital services.

## Conclusion

The course of industrialization in South Korea brought increased employment, especially in the information sector, and new pressures for telecommunications services that pushed the telephone system toward rapid development. These pressures came about in two ways, from business demand for telephone connections and lines, and residential demand for telephones in the late 1970s following the rise in personal incomes brought by Korea's industrial success. An important link between the total industrial growth and telephone development lies in the increase in the numbers of people for whom the telephone was a necessary and affordable communications channel.

The pace of growth of the information sector, and its high demand for telecommunication inputs, assuredly contributed to the increasing pressure of telephone demand. The recognition of a relation between information sector activity and telecommunications use in the context of social development toward an information society began to affect Korean telecommunications policy beginning in 1980. The latest plan of the South Korean government to install an ISDN telephone system is based on perceiving the need to "upgrade the communication network and thus hasten the emergence of the information-oriented society." (ETRI, 1985, p.670)

## Summary and Conclusions

The evidence from the case studies of Ireland and South Korea appears to confirm the hypothesis that the growth of a country's information sector has an impact on telecommunication policies to invest in the telephone system. In both countries the information sector grew out of the industrialization process, increasing more rapidly than employment in the manufacturing sector. Within several years of the rise in information sector employment the telephone systems in each country became overloaded, unable to cope with the increasing demand for telephone connections. And this situation led directly to government decisions that initiated large-scale investment to rebuild a totally modern telecommunications infrastructure.

Considering the time sequence of information sector growth and the change in telecommunications policy, it is likely that the change in the rate of growth in this sector was one factor that had a great impact on the telecommunications bottleneck. A sudden increase in the size of the information sector could explain the surge of applications for telephone service, as well as the increases in telephone traffic that occurred at the end of

the 1970s in both countries. Figure 3 compares the changes in the percentage of of the information sector employment in Ireland and South Korea between the years 1971 and 1983. While the size of the information sector differs in each country, they both demonstrate rapid growth in the mid 1970s.

Figure 3: Percentage Employed in Information Sector in Ireland and South Korea, 1971-1983

IRL = Percentage employed in Irish information sector
SK = Percentage employed in South Korean information Sector

In South Korea information sector growth began to accelerate about 1976, doubling its annual rate of increase over previous years, and continuing into the 1980s; in Ireland information sector growth began to curve upward in 1977. In both cases the upward growth curve began two to three years before the height of the telecommunications bottleneck, and the subsequent accelerated development programs.

Applications for connection began to increase in both countries during the time period in which information sector employment began to climb upwards. Despite efforts in both countries to step up the installation of telephones, the waiting lists for connection rose to levels unforeseen by either telecommunications authority. In Ireland the number of people on the waiting list more than doubled between 1976 and 1980; in South Korea the waiting list figures nearly tripled.

What happened, one might ask, that the telecommunication authorities let the number of customers waiting for connection

accumulate to such a level? One explanation may be that the level of investment capital was too low to support the rapid growth of the telephone system required to handle the demand for connections. A related explanation may be that the surge of applications was unexpected, and caught the telecommunications authorities unprepared for the requisite expansion of the system necessary to incorporate all those demanding connection. In either case the P&Ts ability to deliver a telephone fell far behind the actual demand for one.

Telephone traffic also began to increase sharply in the wake of the information sector growth. An increase in the amount of telephone use should be expected by virtue of the fact that more telephones were being installed every year. However, the network congestion experienced on the Irish telephone system suggests that the amount of telephone traffic was increasing much faster than the system could handle. Telephone traffic over the Irish system doubled between 1976 and 1980. In South Korea the volume of telephone traffic also began to increase sharply after 1976; between 1978 and 1982 in quadrupled, indicative of the demand for communications within the country.

Both of these factors - application for connection and telephone traffic - combined to push the respective telephone systems into a bottleneck. Not only was it difficult to acquire a telephone, network congestion hindered the ability of the telecommunication authority to provide adequate service.

In both Ireland and South Korea investment into the telephone system began to increase at about the same time that the respective information sectors began their growth. But the real rise in capital investment did not occur in either case until 1979-80. In these years government telecommunication policies tried to counterbalance the overloaded telephone systems by pouring money into telecommunication projects. Between 1979 and 1982, the Irish annual investment increased by 130%; South Korean investment increased by 200%.

The policy statements that accompanied each of the accelerated development programs stressed the importance of a good telephone system for the nation's continued economic growth. As the process of industrialization drove the growth of the information sector, it was vital to develop the country's telephone system so that the information sector could function productively. While demand, per se, may not impact telecommunication investments (see: Saunders, 1983), the source of the demand must be considered when it is bound up with economic development.

From the policy statements that accompanied the accelerated telecommunication programs in both countries the communication needs of industry appear to play a prominent role. The Irish were concerned about their economic future, and perceived telecommunications as a vital link between Irish industrial production and European and American markets. South Korean policy statements

looked forward to an information-intensive society with an industry based on high technology manufactures, and called for telecommunication development to provide the communications infrastructure necessary to secure such a future.

In both Ireland and South Korea the impelling argument for telephone system development was economic rather than social, implying that the rise of the information sector and its need for communications inputs was becoming a vital factor in the continuing success of each country. Telecommunication policy in each instance was driven towards change because of a telephone system bottleneck that threatened to hold back the industrial progress that each country was pursuing.

The point to be made here is that in neither case did the telecommunications policy anticipate the oncoming bottleneck. The decision to invest heavily in each telephone system only came after the potential for economic problems became apparent. Can other countries learn something from this pattern? It seems clear that a better model of telecommunications growth is needed to assist in policy planning, especially in the developing countries which must maximize scarce capital for investment. Using the growth of the information sector as an indicator for future communication needs, the developing countries could be in a better position to predict their telecommunication development needs.

From the evidence in the two case studies, there does appear to be a strong relation between telecommunication development and the growth of the information sector. If the pattern of information sector growth leading to a telecommunications bottleneck and subsequent investment decisions holds in two cases, it may hold in many others. A sudden rise in employment in the information sector could act as a barometer of approaching telecommunications change. By monitoring the growth of this sector and the parallel changes in telecommunications policy, we may understand better the dynamics of telecommunications development.

By and large the growth of the information sector has been overlooked by development research, as has its relation to telecommunications development. But it seems clear that communications activity arising from within the information sector has an impact on telephone system in the NIC's as well as in the industrialized world. The problem of telephone development becomes even more serious for the NIC's that have a heritage of poor telecommunications, yet are experiencing rapid industrial or information sector growth. Research into the relation between telephone development and the growth of an information sector within these countries needs to be diligently addressed.

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Tues. 10

Joseph N. Pelton: Trends in International Telecommunications Development in the Third World

During the eighties there has been a profound shift in the nature of telecommunications development in Third World countries. Planning has begun to extend the telephone and television network into rural and isolated areas, rather than exclusively focusing on just linking capital cities with major regional cities where virtually all telephones and television sets are concentrated in developing countries. New satellite facilities, smaller and lower cost earth stations, new terrestrial communications equipment such as VHF radio telephone service, new financing schemes, and better recognition of how telecommunications can be applied to education, health, agriculture, storm warning, etc. are key factors in this shift. Project SHARE, Ruralsat, and the new Center for Telecommunications Development are also aiding the move into rural and isolated regions.

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John K. Mayo

Tues 11

The Rural Communication Services Project (RCSP) was a development initiative co-sponsored by ENTEL-PERU and the U.S. Agency for International Development from 1979 through 1986. It was designed: (1) to provide reliable and cost-effective telephone service via satellite and ancillary radiolinks to a remote region of Eastern Peru; (2) to determine the demand for telephone by rural residents and regional development agencies; and (3) to assess the potential of audio-teleconferencing for meeting the latter's administrative and distance training needs. A comprehensive evaluation by researchers from ENTEL and Florida State University documented the project's achievements in the above areas and, at the same time, illuminated the range of technical, programmatic and management issues which sponsors of future, large-scale rural telecommunications systems are likely to encounter.

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